Assessment of the impact of COVID-19 mitigation strategies on the costs of distributing insecticide treated nets in Mozambique: a budget impact analysis

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For IFRC

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Acronyms

AMP	Alliance for Malaria Prevention
CCU	Universal Coverage Campaign
GFATM	Global Fund to Fight Aids, Tuberculosis and Malaria
IFRC	International Federation of Red Cross and Red Crescent Societies
IG2	Interceptor G2 insecticide-treated net
ITN	Insecticide-treated bed net
LLIN	Long lasting insecticide treated net
PBO	Piperonyl butoxide insecticide-treated net
PMI	President's Malaria Initiative
PNCM	National Malaria Control Program
SDMAS	District Services for Health, Women and Social Action
WHO	World Health Organization
WV-M	World Vision Mozambique

Background and purpose

Vector control has contributed substantially to the global reduction in malaria burden that has been observed since 2000, primarily through regular mass distribution and increased use of insecticide-treated bed nets (ITNs) and the indoor residual spraying (IRS) of insecticides. The ITN is a core tool for malaria prevention and there has been a massive increase in mobilized funds and resources towards the procurement of ITNs to prevent the disease since 2000, resulting in unprecedented levels of vector control coverage across sub-Saharan Africa.[1] Between 2000 and 2020, global malaria incidence rates fell by 27 percent and mortality rates by 39 percent. Over 10 million deaths were averted, primarily among children less than five years of age.[2]

The Alliance for Malaria Prevention (AMP) is a workstream within the RBM Partnership to End Malaria. AMP is a partnership of more than 40 organizations, including government, private sector, faith-based and humanitarian organizations. AMP is housed and chaired by the International Federation of Red Cross and Red Crescent Societies (IFRC). AMP provides distance and in-country support to national malaria programmes and partners for mass ITN distribution campaigns as well as operational guidance on all aspects of ITN distribution.

[1] Bhatt S, Weiss DJ, Mappin B, Dalrymple U, Cameron E. Coverage and system efficiencies of insecticide-treated nets in Africa from 2000 to 2017. Elife. 2015;4:e09672.
[2] WHO. World Malaria Report 2021.. https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2021

With the WHO declaration of the COVID-19 pandemic, AMP focused on the development and dissemination of technical guidance for the conduct of ITN distribution campaigns during the COVID-19 pandemic and the provision of distance support for ITN mass campaigns. Over 25 countries accessed operational guidance and distance technical support from AMP to adapt ITN distribution strategies in 2020 in order to sustain gains achieved in the fight against malaria in the context of the COVID-19 pandemic. The cost implications of the adapted strategies across different country contexts are not well understood but are important to assess for planning and implementation of future campaign distributions in the context of COVID-19.

The main goal of this work is to assess the cost implications for COVID-19 adapted campaigns implemented in Mozambique in 2020. The National Malaria Control Programme has opted to maintain the adapted approach for 2022/2023 and understanding the cost implications of the shift in approach will facilitate planning and budgeting for future campaigns. This work aims to accurately identify the key cost drivers and provide a robust sensitivity analysis for the components driving costing changes in the campaigns.

Methods

Intervention description development

A description of the intervention was developed based on document reviews.

Timeframe and perspective

The study analyzed cost data from the provider perspective and used a one-year time frame to reflect the duration of the ITN distribution campaign. These analyses follow a budget analysis approach. The major activities involved in producing cost estimates of ITN programs are information gathering, program description, data collation and cleaning, and analysis and reporting.

Types of costs included

We attempted to include all financial costs associated with the distribution of nets in Mozambique's 2019 (pre-COVID-19) and 2020 Universal Coverage Campaign (CCU) in selected provinces from the perspective of the providers of the intervention, including the National Malaria Control Program (PNCM), international donors, non-governmental organizations, and health care workers, but not household-level costs. No indirect costs, such as lost productivity or treatment seeking costs, were included, nor were any purely economic/opportunity costs such as volunteer time or donated space or equipment. The primary approach (using budgeted costs) however, means that financial costs which were not included in the budgets that we were able to access may be missed.

Data collection

Cost data were collected retrospectively mainly from budgets, but additional sources include operational records, after-campaign reports kept by implementing partners and ITN purchase invoices. Costing data included a 2019 CCU campaign budget drafted for one province the before the COVID-19 pandemic (pre-COVID-19) and a budget adapted for COVID-19 mitigation (post-COVID-19) for seven other provinces. Net procurement and logistics costing data were procured from purchase invoices.

The target areas for this analysis included seven provinces that participated in the CCU during the COVID-19 pandemic in 2020, and one province that budgeted pre-pandemic.

Cost classification and adjustments

Costs were collected in the Mozambique Metical (MZN). Costs collected in Metical were converted to USD at a rate of 1 USD to 71.3151 MZN[3].

Assessment of the impact of COVID-19 mitigations on budgets

Budget line-items potentially affected by COVID-19 mitigations were identified by analyzing post-campaign reports on COVID-19 mitigations. Estimation of the impact of COVID-19 adaptation was conducted through direct line-item by line-item comparison to a pre-COVID-19 campaign budget from the same campaign cycle. Changes in line-item quantities, costs, and totals were compared to qualitative data on applied COVID-19 mitigations collected from post-campaign reports and analyzed for relevancy, supported by interviews with implementers.

Outputs and sensitivity analysis

Costs are reported in three ways: total financial cost of the program, total cost by activity and line-item group, and cost per net distributed (also by activity group, line-item group, and line-item). Percent change in total budget and change in cost per net distributed will be presented to assess any impact of COVID-19 mitigation on the cost of ITN distribution. Changes are also presented by activity code, line-item group, and specific line-items, where appropriate. A one-way sensitivity analysis was conducted around exchange rates and numbers of nets distributed.

Base case scenario

In this analysis, the base case scenario uses the two budgets as presented. The validity of the base analysis then implies that both the pre-COVID campaign and the COVID-19 mitigated campaign budgets are accurate, complete, and reflect reasonably well the actual expenditure and resource use that was involved (or would have been involved) in the delivery of the nets through the CCU.

Results

Data collection

Data were collected from Mozambique partners in the PNCM and the Global Fund to Fight Aids, Tuberculosis and Malaria (GFATM). Documents collected include a campaign manual for 2020, post-campaign report from 2021, and campaign budgets from 2019 and 2020. Due to limitations in data availability, Maputo was excluded from post-COVID calculations and Nampula was excluded from pre-COVID calculations as the campaign was completed in 2019 before the COVID-19 onset.

Intervention description

Mass ITN campaign

[3] Exchange rate based on Google Finance data, queried year 2020, https://exchangerates.org/usd-to-mzn

The 2019/2020 CCU in Mozambique began in July 2019 and ended in December 2020, with the later distribution cycles facing delays due to ITN shortages, and other causes. ITN distribution in the provinces of Cabo Delgado and Nampula was completed prior to pandemic-related lockdowns in early 2020. The provinces of Niassa and Zambézia were the first to resume ITN campaign activities when lockdown measures lifted in mid-September 2020. The campaign aimed to distribute one net to every two people by distributing 17.3 million ITNs to a population of about 33 million and 7,411,775 households.

The national campaign was a multi-product campaign with PBO, Interceptor G2, and Royal Guard ITNs in addition to standard long-lasting insecticidal nets (LLINs). The average freight on board (FOB) cost per standard LLIN was 2.20 USD with an additional cost of 0.49 USD per net for delivery to a nearby port city within Mozambique for a total of 2.69 USD. The average FOB cost per non-standard ITNs was 2.91 USD with an additional cost of 0.64 USD per net for delivery for a total of 3.55 USD.

Prior to the onset of the COVID-19 pandemic, campaigns were conducted in "two phase" systems by which households were first enumerated and assessed for eligibility to receive ITNs and given vouchers that they could later redeem for ITNs at fixed distribution points established nearby. Following the household registration, data analysis was completed and ITN needs for fixed sites identified to facilitate planning for transport of sufficient ITNs to fixed distribution points. Due to the need to reduce crowding at distribution points with the onset of the COVID-19 pandemic, the distribution strategy shifted to a single-phase door-to-door approach in which simultaneous registration and distribution took place. Other major changes relative to previous campaigns included transitioning to community-led registration and distribution to reduce long-distance travel and requiring personal protective equipment (PPE) at in-person meetings. Table 1 describes the distribution timeline and differences between the nine provinces of the 2019/2020 CCU. Rows one and two in Table 1 show pre-pandemic provinces while rows three through nine show pandemic-adapted campaigns.

Table 1. Administrative demographic data for the 2019/2020 Mozambique CCU, disaggregated by Province, derived from microplans

No.	Province	Dates of campaign (distribution phase)	Pre-post pandemic	Phases	Registered Population	Registered Households	No. of Districts
1	**Cabo Delgado**	July 2019	Pre	two	3,028,466	638,739	17
2	**Nampula**	July - Aug. 2019	Pre	two	7,882,313	1,602,441	23
3	**Niassa**	Oct. 2020	Post	one	2,451,222	560,126	16
4	**Zambezia**	Aug. - Oct. 2020	Post	one	6,984,373	1,636,037	22
5	**Tett**	Nov. 2020	Post	one	3,467,435	819,587	15
6	**Manica**	Nov. 2020	Post	one	2,530,258	616,130	12
7	**Sofala**	Nov. 2020	Post	one	3,008,356	703,706	13
8	**Inhambane**	Dec. 2020	Post	one	1,761,363	448,490	14
9	**Gaza**	Dec. 2020	Post	one	1,715,026	386,519	14
	Total	**Jul 2019 - Dec. 2020**			**32,828,812**	**7,411,775**	**146**

Engagement meetings

In each of the provinces and districts, engagement meetings were held. In 2019 in Cabo Delgado and Nampula, the meetings were attended by provincial- and district-level government officials, members of

the District Services for Health, Women and Social Action (SDMAS), and chaired by the Director of the PNCM at province level.

Due to COVID-19, the remaining provinces reduced the number of participants in their engagement meetings and limited participation to the provincial levels. District-level engagement meetings were maintained with a strict participation of district-level personnel, and a similar approach was taken for local-level meetings with community and religious leaders. COVID-19 mitigation protocols limited the number of participants in meetings, emphasized physical distancing, and mandated supplies of hand sanitizer, masks, and other COVID-19 mitigation materials.

Localized coordination structures

Task forces were established at the district level to streamline local-level campaign implementation. The task forces were responsible for supporting the decentralization of implementation efforts, with the aim of reducing long-distance travel.

Operations and microplanning

Needs for PPE and other COVID-19 mitigation materials were identified and quantified at the microplanning stage. Implementation of the campaign was government-led through the combination of district and local government structures and national agencies. Provinces were clustered together based on region and distribution took place sequentially.

Training

Cascade training was used with face-to-face training in smaller groups of multidisciplinary teams at central, district, and local levels. Online platforms were not utilized for training purposes. In 2019, training of registrars and distributors was held separately at the district level. Pre-pandemic registrars were taught to utilize three tools: registration forms, rolls of stickers (for household marking), and rolls of vouchers. In 2020, registrars and distributors were trained simultaneously and were not taught to use vouchers as distribution would not take place at a centralized location.

Logistics

The ITNs were unloaded from the various ports (Maputo, Beira and Nacala) directly to the headquarters of each district, in 40-foot containers, all sealed and were only opened at the time of unloading. Some provinces were able to secure province-level warehousing at no cost, but this was not the case for all districts. All warehouses were managed by contractors and had increased security, from provincial down to community-level.

Reverse logistics were also affected by the pandemic. In 2019, ITNs arrived at the district warehouses from the manufacturer and were then moved to distribution posts, to satellite warehouses, and to the distribution points. Pre-pandemic reverse logistics followed the same flow in reverse, with the district warehouse being the final destination. In 2020, satellite warehouses were removed, and community warehouses were created, where ITNs were distributed from the community warehouse to local distribution teams closest to their distribution locations. The reverse logistics in 2020 followed the same flow back up to the district level, although from community warehouse direct to district warehouse.

Registration and distribution

In response to the COVID-19 pandemic, household registration and ITN distribution were combined into a single-phase distribution mechanism in 2020. In 2019, the registration of households was carried out in eight days. Quality assessment checks for household (HH) registration took place on the third day to assess and review various aspects related to improving the quality of the implementation. In 2020, registration and distribution were combined into a 15-day period and the quality assessment checks were not carried out. It was noted that the 15-day period resulted in a higher percentage of registered HHs.

Social and behaviour change

In response to pandemic-related limitations on interpersonal communication, mobile brigades were used to disseminate key messages about COVID-19 and pandemic prevention measures. Social and behaviour change consisted primarily of radio programs and visibility materials to reinforce concepts of net care, repair, and repurposing in addition to other malaria preventive messages. Advocacy meetings were held in all districts.

Supervision and monitoring

Campaign supervision took place at different levels: central, provincial, and district. Supervisors oversaw all stages, from warehousing to distribution. Face-to-face supervision was combined with remote methods via WhatsApp groups.

Adaptations implemented after the onset of COVID-19 pandemic

Key adaptations for the 2019/2020 ITN campaign are summarized in Table 2.

Table 2. Key campaign adaptations for the COVID-19 context

Campaign elements	COVID-19 adaptation/mitigation
Risk mitigation strategies	• Campaign method adjusted from a two-phase to a one-phase design to reduce exposure • Remove use of vouchers to limit exchange of materials between individuals • Decentralize campaign efforts to local levels
Microplanning	● Implement physical distancing for in-person meetings ● Secure funding for personal protective equipment (masks, alcohol gel, buckets, soap)
Social and behaviour change	● Reduce number of participants in face-to-face meetings ● Procure PPE for campaign personnel ● Promote use of face masks, hand sanitizers and physical distancing
Procurement/ logistics	● Conducting simultaneous registration and distribution exercise ● Change distribution methods from a two-phase system with distribution points to a one-phase system with door-to-door registration distribution ● No voucher procurement

Implementation (registration and distribution)	• Maintain physical distancing during distribution of at least one meter • Use of face masks for the distribution teams • Pre-position ITNs in community warehouses which supply distribution teams directly • Security personnel to accompany campaign personnel

Costs

The type and number of ITNs planned for distribution in targeted provinces in Mozambique is shown in Table 3. Rows one and two in Table 3 show pre-pandemic provinces while rows three through nine show pandemic-adapted campaigns.

Table 3. Mozambique 2019/2020 net procurement details by province and ITN type

No.	Province	Standard	PBO	IG2	Royal Guard	Total: ITN per Province
1	**Cabo Delgado**	--	1,466,505	--	--	**1,466,505**
2	**Nampula**	3,880,205	--	--	--	**3,880,205**
3	**Niassa**	--	--	834,118	568,809	**1,402,927**
4	**Zambezia**	4,148,316	--	--	--	**4,148,316**
5	**Tett**	--	1,879,354	--	--	**1,879,354**
6	**Manica**	--	--	1,308,500	--	**1,308,500**
7	**Sofala**	1,952,089	--	--	--	**1,952,089**
8	**Inhambane**	980,466	--	--	--	**980,466**
9	**Gaza**	949,052	--	--	--	**949,052**
	Total: ITN Type	**11,910,128**	**3,345,859**	**2,142,618**	**568,809**	**17,967,414**

In all provinces, the HH estimate from the microplan was lower than the number eventually registered during implementation of the campaign registration. In total around 17 million nets were planned for distribution to a population of approximately 33 million people.

Cost breakdown

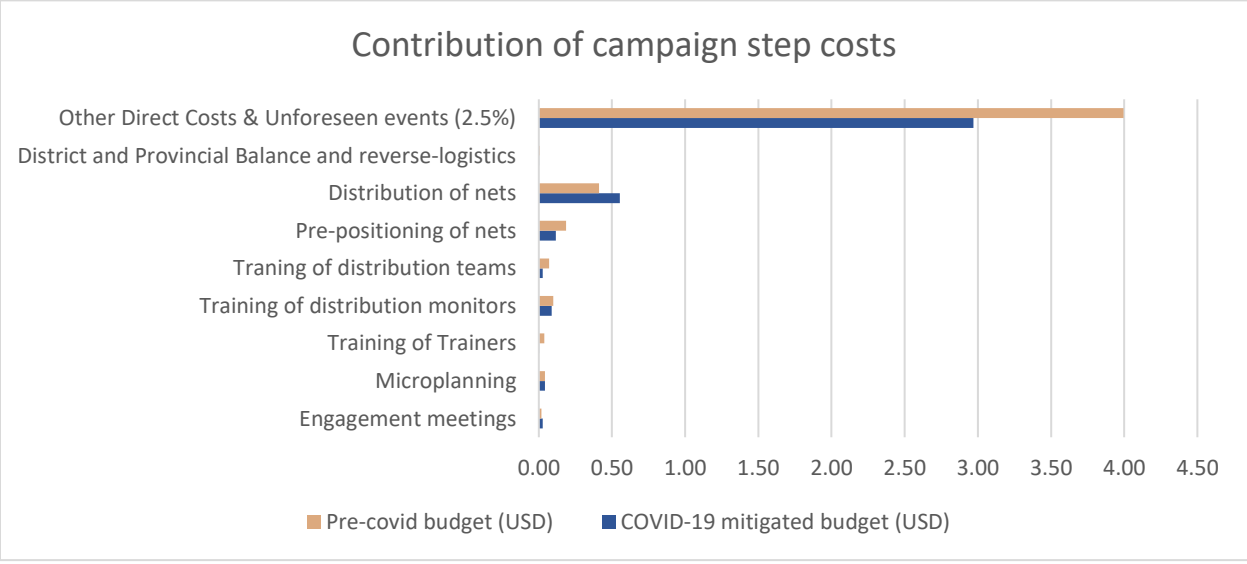
Costs are presented by activity codes utilized by the campaign budget, and by a line-item group coding system where relevant cost-drivers were identified.

Table 4 and Figure 1 show the financial cost per net distributed and the contribution of each campaign step to the total cost. Costs are presented in Table 4 including estimates from COVID-19 adapted/mitigated budgets as well as the pre-COVID-19 budget. The cost of each net and shipping from the manufacturer are included under “Other direct costs”.

Table 4: Financial costs per net distributed, by campaign step

Campaign Step	COVID-19 mitigated budget (MZN)	Pre-COVID-19 budget (MZN)	COVID-19 mitigated budget (USD)	Pre-COVID-19 budget (USD)	Percent change from pre-COVID budget (Post – Pre)/Pre
Engagement meetings	MZN 1.94	MZN 1.32	$ 0.03	$ 0.02	46.9%
Microplanning	MZN 2.95	MZN 3.00	$ 0.04	$ 0.04	-1.7%
Training of trainers	MZN 0.02	MZN 2.64	$ 0.00	$ 0.04	-99.4%
Training of distribution monitors	MZN 6.34	MZN 7.07	$ 0.09	$ 0.10	-10.3%
Training of distribution teams	MZN 1.86	MZN 5.05	$ 0.03	$ 0.07	-63.1%
Pre-positioning of nets	MZN 8.33	MZN 13.36	$ 0.12	$ 0.19	-37.6%
Distribution of nets	MZN 39.49	MZN 29.40	$ 0.55	$ 0.41	34.3%
District and provincial wrap up meetings and reverse-logistics	MZN 0.04	MZN 0.45	$ 0.00	$ 0.01	-91.2%
Other direct costs & unforeseen events (2.5%)	MZN 211.76	MZN 284.91	$ 2.97	$ 4.00	-25.7%
Total	**MZN 273**	**MZN 347.20**	**$ 3.82**	**$ 4.87**	**-21.4%**

Figure 1: Contributions of campaign steps to overall budget in post COVID-19 and pre COVID-19 campaigns



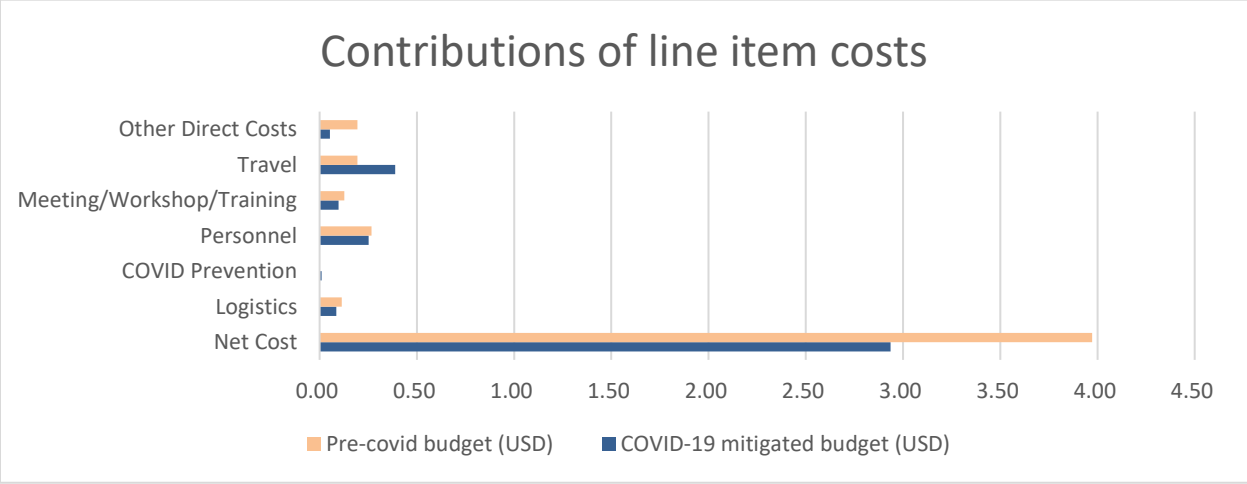
The total budgeted cost of distribution was 0.90 USD per net in the pre-COVID-19 budget, and this decreased to 0.89 USD in the post-COVID-19 budget (1%) decrease. In terms of campaigns steps, changes were seen most in an increase in registration/distribution costs and a decrease in training costs (44% decrease total) due to the shift to a single-phase campaign, resulting in a reduced number of trainings. The category for "Other direct costs" includes the cost of the net as well as COVID-19 prevention measures and other direct costs. When the cost of nets is removed, we see in increase in that category by 42% and the equivalent of 0.01 USD per net.

Table 5 and Figure 2 show the financial costs per net distributed categorized by line-item group and include net costs and shipping from the manufacturer under 'Net cost'.

Table 5: Financial costs per net distributed, by line-item group

Line-item group	COVID-19 mitigated budget (MZN)	Pre-COVID-19 budget (MZN)	COVID-19 mitigated budget (USD)	Pre-COVID-19 budget (USD)	Percent change from pre-COVID budget (Post – Pre)/Pre
Net cost	MZN 209.44	MZN 283.27	$ 2.94	$ 3.97	-26.1%
Logistics	MZN 6.08	MZN 8.12	$ 0.09	$ 0.11	-25.0%
COVID Prevention	MZN 0.77		$ 0.01		
Personnel	MZN 17.99	MZN 19.02	$ 0.25	$ 0.27	-5.4%
Meeting/ Workshop/ Training	MZN 6.95	MZN 9.10	$ 0.10	$ 0.13	-23.6%
Travel	MZN 27.71	MZN 13.86	$ 0.39	$ 0.19	100.0%
Other direct costs	MZN 3.78	MZN 13.83	$ 0.05	$ 0.19	-72.7%
Total	**MZN 273**	**MZN 347**	**$ 3.82**	**$ 4.87**	**-21.4%**

Figure 2: Contributions of line-item groups to overall budget in pre-COVID-19 and post-COVID-19 campaigns



The single largest cost driver (aside from nets themselves) in the pre-pandemic budget is personnel costs which did not see much change with the shift to single-phase distribution in the pandemic-adapted campaigns. Travel costs were the main cost driver in the pandemic adapted budgets where significantly more travel money was budgeted for training and registration/distribution. The second largest change seen in the budgets after travel expenses was seen in "Other direct costs" and is attributed primarily to the line item for 'news coverage of distribution and post distribution activities' which was not budgeted for in the pandemic-adapted campaigns. COVID-19 mitigation measures accounted for 0.01 USD per net, 0.3% of the overall budget.

One-way sensitivity analysis

Table 6 shows the results of one-way sensitivity analysis. Resilience towards assumptions was tested.

Table 6: Sensitivity analysis of selected parameters, per net distributed (USD)

Sensitivity Analysis parameter adopted value	Pandemic-adapted costs (USD)	Pre-COVID-19 costs (USD)	Resulting change in cost per net (%)	Rationale
Base Case Scenario	**$ 3.82**	**$ 4.87**	-	-
Exchange rate decreased to 59 MZN per USD from 71.3151 MZN	$ 4.01	$ 5.06	4.3%	Exchange rate of 59 was used in the 2019 Mozambique budgeting
Exchange rate decreased to 68.85 MZN per USD from 71.3151 MZN	$ 3.86	$ 4.90	0.7%	Exchange rate of 68.85 was used in the 2020 Mozambique budgeting
Net cost for both pre- and post-COVID campaigns is set to 3.00 USD per net	$ 3.89	$ 3.90	-9.2%	3.00 USD is the average cost per net across both campaigns

These results indicate that neither the exchange rate chosen, nor the total numbers of nets assumed in the study have a major impact on the magnitude of the increase in costs due to COVID-19. Since both assumptions are applied across the pre and post COVID-19 budgets this is not a surprise. When the net cost is set equal in both campaign budgets, the difference between the pre- and post-COVID campaign budgets is reduced to 0.01 USD per net.

Discussion

COVID-19 mitigations did not meaningfully change the per net cost of insecticide treated net distribution in Mozambique in 2020, though large changes in some budget lines did occur likely as a result of pandemic mitigation efforts. These changes were mainly driven by changes in travel line items and changes during net distribution. While some activity and line-item costs (notably meeting costs) decreased, these cost-savings were offset by the increased travel costs in other domains and the cost of PPE procurement.

While the overall change in the cost of distribution was small ~2%, this cost estimate neglects the cost of the ITNs themselves. The impact of this change on the overall budget including the ITN would be negligible. Because the overall impact on cost of ITN interventions is minimal, COVID-19 mitigations are not expected to greatly impact the cost-effectiveness of ITN interventions, which remain some of the greatest value for money in malaria programming and global health in general. In the case of Mozambique distribution, the higher budgeted cost for ITNs pre-pandemic led the cost per net of the mitigated campaign to appear much lower than the pre-COVID campaign despite the small change in the distribution components.

Given that a major impact of the COVID-19 pandemic was on the global supply chain, including on the supply of ITNs, there was a significant potential for disruption in ITN distribution with devastating impacts on health from reduced access to malaria prevention (as only one aspect of many impacts of the pandemic). For this reason, it was critical that ITN campaigns be conducted as closely as possible to pre-planned schedules. At the time of planning for these campaigns there was no evidence base on the potential budget impacts of necessary mitigations to operate ITN distribution campaigns with COVID-19 mitigations. This work provides some of the first empirical evidence that COVID-19 mitigated campaigns can be conducted successfully for very small relative increases in cost.

This work has substantial limitations. Costs were estimated mainly from budget documents and may therefore reflect over or underestimates of true financial expenditure and/or resource use. While mass ITN campaigns tend to rely less on donated resources or local uncompensated use of facilities and personnel compared to continuous distribution strategies, they may still rely on local resources which are unbudgeted or financially recorded (such as province-level warehousing). These costs are not included in this analysis and therefore it likely underestimates the true economic cost of distribution.

Secondly, since budgeting does not reflect financial expenditure perfectly it is possible that the impact of the COVID-19 pandemic on the ITN distribution had impacts (such as delays to campaign operations with associated costs which are not reflected in the budget). While this may not affect the budget as planned or the analysis presented directly, it is unclear if the budgets provided in this analysis would have been sufficient to account for interruptions to campaign operations due to increased absenteeism, isolation or quarantine or lockdowns leading to campaign delays and additional storage, among other, costs.

Conclusion

COVID-19 mitigations may increase the cost of ITN distribution; however, this increase is likely to be modest. The overarching finding hides underlying heterogeneity in line-item and activity specific effects, with some areas, such as travel costs and household enumeration/distribution costs increasing, especially in the context of a shift to a single-phase campaign. The effect on distribution budgets is minor, but the impact on the overall campaign budget including the cost of nets is much smaller relatively, and negligible. Programs may need to consider accounting for COVID-19 mitigation measures when planning future ITN campaigns, but these costs should not substantially affect the cost-effectiveness of the intervention itself.